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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/600,593	07/19/2000	Christian Lutz	1959/49027	5222

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Evenson McKeown Edwards & Lenahan
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Washington, DC 20005

EXAMINER

BINDA, GREGORY JOHN

ART UNIT

PAPER NUMBER

3679

DATE MAILED: 01/24/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

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Office Action Summary

Application No.

09/600,593

Applicant(s)

Lutz

Examiner

Greg Binda

Art Unit

3679

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE three MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136 (a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on Dec 4, 2002
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 20-37, 39-41, 44-46, and 48-56 is/are pending in the application.
- 4a) Of the above, claim(s) 22, 24, 26, 28, 31-35, and 51-55 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 20, 21, 23, 25, 27, 29, 30, 36, 37, 39-41, 44-46, 48-50, and 56 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claims _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on Jul 19, 2000 is/are a) ☐ accepted or b) ☒ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☒ The proposed drawing correction filed on Dec 4, 2002 is: a) ☐ approved b) ☒ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☒ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

*See the attached detailed Office action for a list of the certified copies not received.

- 14) ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s). _____ 6) ☐ Other:

Art Unit: 3679

1. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

Continued Examination Under 37 CFR 1.114

2. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on Dec 4, 2002 has been entered.

Election/Restriction

3. Claims 22, 24, 26, 28, 31-35 & 51-55 are withdrawn from further consideration pursuant to 37 CFR 1.142(b) as being drawn to a nonelected species, there being no allowable generic or linking claim. Election of Species I (Figs. 1-3) was made **without** traverse in Paper No. 11.

Drawings

4. The corrected or substitute drawings were received on Dec 4, 2002. These drawings are disapproved because:
 - a. The drawing sheet including Fig. 3 fails to include Fig. 3a. See the drawing changes filed May 29, 2001.

Art Unit: 3679

b. The drawing sheet including Fig. 3b includes a figure that is not included in the brief description of the drawings.

5. The drawings are objected to as failing to comply with:

a. 37 CFR 1.83(a) because the drawings do not show structure corresponding to the following claim limitations:

i. Claim 41: "the slide bushing is resiliently held by the socket"

ii. Claim 45: "the bushing is resiliently disposed in the socket"

b. 37 CFR 1.84(h)(5) because Figure 3 shows modified forms of construction in the same view. See "In the bottom half [of Fig. 3] another variant of the tumbler sleeve mounting is shown" on page 10, line 11. (This objection would have been overcome if the corrected or substitute drawings received on Dec 4, 2002 had been approved.)

6. The drawings are objected to because the socket 7 shown in the upper half of Fig. 3 does not appear to be "resiliently pivotally" mounted to the shaft end 2 as recited in claims 20 & 44.

This is so because there is no radial clearance which would allow such pivoting between the flange 33 and the annular chamber 34 of the fork 6.

Specification

7. The disclosure is objected to because:

Art Unit: 3679

a. In the paragraph at the top of page 8, applicant thrice refers to shaft ends 1 & 2 as "shaft ends 2 & 3". See the latest edition of this paragraph in the amendment filed Dec 4, 2002, Paper No. 21.

b. In the paragraph at the bottom of page 10, applicant refers to a figure, Fig. 3b, that is not included amongst the accepted drawings. See the latest edition of this paragraph in Paper No. 21. (This objection would have been overcome if the corrected or substitute drawings received on Dec 4, 2002 had been approved.)

8. The specification is objected to as failing to comply with 37 CFR 1.71 and 1.75(d)(1) because the detailed description fails to provide proper antecedent basis for the following claimed subject matter:

a. Claim 41: "the slide bushing is resiliently held by the socket"

b. Claim 45: "the bushing is resiliently disposed in the socket"

Claim Objections

9. Claims 20 & 44 are objected to because each includes a misspelling of the word, "pivotally".

Claim Rejections - 35 U.S.C. § 112

Art Unit: 3679

10. Claims 41, 45, 48 & 49 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention. Claim 41 recites the limitation, "the slide bushing is resiliently held by the socket" and similarly, claim 45 recites the limitation, "the bushing is resiliently disposed in the socket". However, the drawings of the elected species do not show and the description of the elected species does not describe a resilient interface between the slide bushing 11 and socket 7. The description of the elected species does not even give a reason such a feature. (Note: Fig. 3 does show and the description at page 9, lines 18+ does disclose the socket 7 resiliently disposed (via the springs 31) in the annular chamber 34 of the fork 6. This feature corresponds to the limitation in the last lines of claim 20.)

11. Claims 20, 21, 23, 25, 27, 29, 30, 36, 37, 39-41, 50 & 56 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

a. Claim 20, lines 3 & 4 recites the limitation, "the two joints". There is insufficient antecedent basis for this limitation in the claim since just a single joint (see "the joint in line 2) is previously recited.

b. Claim 27 recites the limitation "the bushing". There is insufficient antecedent basis for this limitation in the claim.

Art Unit: 3679

c. Claim 29, line 2 recites "a fork". It is not clear how this fork is connected to the previously recited elements in the claim.

d. Claim 29, line 2 recites "a fork". It is not clear if this fork is included with, or exclusive of the two joints recited in claim 20, lines 3 & 4.

e. Claim 50 recites the limitation, "The joint according to claim 47". There is insufficient antecedent basis for this limitation in the claim.

Claim Rejections - 35 U.S.C. § 101

12. Claims 20, 21, 23, 25, 27, 29, 30, 36, 37, 39-41, 44-46, 48-50 & 56 are rejected under 35 U.S.C. 101 because the claimed invention, a "shaft universal double joint", lacks patentable utility. The only known utility of such a double joint is a constant velocity joint (see for example the third full paragraph in the second column of page 100 of *Universal Joint and Driveshaft Design Manual*). However, the claimed invention is not an operable constant velocity joint (see item 10 of the Office action mailed Jun 4, 2002, Paper No. 18). Therefore, unless applicant can identify some other utility, the claimed invention lacks patentable utility.

Claim Rejections - 35 U.S.C. § 102

13. Claims 20, 21, 23, 36, 40, 44 & 46 are rejected under 35 U.S.C. 102(b) as being anticipated by Helmke, CA 604,536.

Art Unit: 3679

a. Claim 20: Fig. 7 shows a double joint with shaft ends 20, 21 fastened against rotation in the joint, these ends being held for movement in a housing 29 joining the two joints and these ends 20, 21 being joined together between the two joints by a ball joint so that a ball 10 connected to one shaft end 20, is mounted for rotation about a center point of the ball in a socket 13 of the shaft end 21 and is slidingly movable in the direction of the shaft axis of the other shaft end 21, wherein the socket 13 is resiliently pivotally mounted to the other shaft end 21.

i. Claim 21: Fig. 7 shows a slide bushing 11 held by the socket 13, the slide bushing 11 being enveloped at least partially by the socket 13 and being disposed between the ball 10 and the socket 13.

(1) Claim 23: Fig. 7 shows that the resiliently pivotally mounting of the socket 13 in the other shaft end 21 includes metal springs.

ii. Claim 36: Fig. 7 shows on an inner wall of the housing 29 that an abutment structure 33 is provided for the ball and the socket.

iii. Claim 40: Fig. 7 shows the socket 13 is resiliently supported in the axial direction.

b. Claim 44: Fig. 7 shows a double joint comprising: two shaft ends 20, 21; two joints 18, 19, each shaft end 20, 21 being connected to one of the joints; a housing 29 joining the two joints 18, 19; and a socket 13 and a ball joint 10 disposed in the socket 13, the shaft ends 20, 21 being joined together between the two joints 18, 19 by the ball joint 10 and socket 13, wherein the

Art Unit: 3679

ball joint 10 is associated with the shaft end 20 and is able to rotate in the socket 13, and wherein the socket 13 is resiliently pivotally connected to the other shaft end 21.

i. Claim 46: see the rejection of claim 40 above.

14. Claims 20 & 44 are rejected under 35 U.S.C. 102(b) as being anticipated by Curtis, US 2,024,912.

a. Claim 20: Fig. 1 shows a double joint with shaft ends 6 fastened against rotation in the joint, these ends being held for movement in a housing 19, 20 joining the two joints and these ends 6 being joined together between the two joints by a ball joint so that a ball 1 connected to one shaft end 6, is mounted for rotation about a center point of the ball in a socket 15 of the shaft end 6 and is slidably movable in the direction of the shaft axis of the other shaft end 6, wherein the socket 15 is resiliently pivotally mounted to the other shaft end (see also col. 2, line 52).

b. Claim 44: Fig. 1 shows a double joint comprising: two shaft ends 6; two joints 9, each shaft end 6 being connected to one of the joints; a housing 19, 20 joining the two joints 9; and a socket 15 and a ball joint 1 disposed in the socket 15, the shaft ends 6 being joined together between the two joints 9 by the ball joint 1 and socket 15, wherein the ball joint 1 is associated with the shaft end 6 and is able to rotate in the socket 15, and wherein the socket 15 is resiliently pivotally connected to the other shaft end 6.

Art Unit: 3679

Claim Rejections - 35 U.S.C. § 103

15. Claims 25 & 39 are rejected under 35 U.S.C. 103(a) as being unpatentable over Helmke in view of Bell, US 4,160,626. Helmke shows all the limitations of the claimed invention except Helmke does not expressly disclose the metal spring in the form of plate springs. In Fig. 3, Bell shows plate springs 92 and teaches in col. 4, lines 40-48, using these springs in order to provide sufficient compression. It would have been obvious to one of ordinary skill in the art to modify the double joint of Helmke by making the spring in the form of plate springs in order to provide sufficient compression as taught by Bell.

Response to Arguments

16. Applicant's arguments filed Dec 4, 2002 have been fully considered but they are not persuasive. Applicant argues that the practical utility of a shaft universal double joint is not limited to a constant velocity joint. However, applicant fails to provide an example or any other evidence to support this argument.

Conclusion

17. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Robinson discloses on page 2, lines 38 a wear compensation means for a universal joint.

Art Unit: 3679

18. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Greg Binda whose telephone number is (703) 305-2869. The examiner can normally be reached Monday through Thursday from 9:30 am to 7:00 pm. The examiner can also be reached on alternate Fridays.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Lynne Browne, can be reached on (703) 308-1159. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 872-9326 (before final), (703) 872-9327 (after final) and (703) 872-9325 (customer service).

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-2168.

**GREGORY J. BINDA
PRIMARY EXAMINER**

Notice of References CitedApplication/Control No.
09/600,593Applicant(s)/Patent Under Reexam
LutzExaminer
Greg BindaArt Unit
3679

Page 1 of 1

U.S. PATENT DOCUMENTS

	Document Number Country Code-Number-Kind Code	Date MM-YYYY ¹	Name	Classification ²	
A	1,556,719	10/1925	Robinson	464	151X
B	2,024,912	12/1935	Curtis	464	151
C					
D					
E					
F					
G					
H					
I					
J					
K					
L					
M					

FOREIGN PATENT DOCUMENTS

	Document Number Country Code-Number-Kind Code	Date MM-YYYY ¹	Country	Name	Classification ²	
N	604,536	9/1960	Canada	Helmke	464	151
O						
P						
Q						
R						
S						
T						

NON-PATENT DOCUMENTS

	Include, as applicable: Author, Title, Date, Publisher, Edition or Volume, Pertinent Pages
U	
V	
W	
X	

* A copy of this reference is not being furnished with this Office action. See MPEP § 707.05(a).

¹ Dates in MM-YYYY format are publication dates.² Classifications may be U.S. or foreign.

464-151

AU 245 46009

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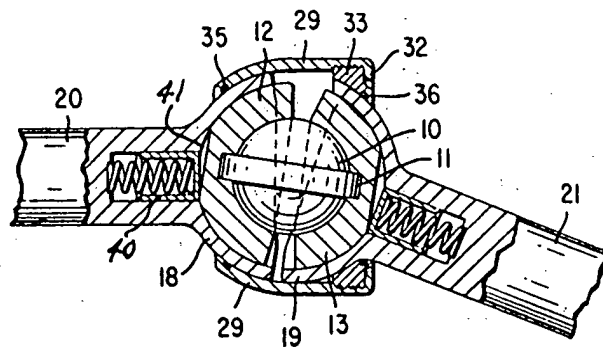
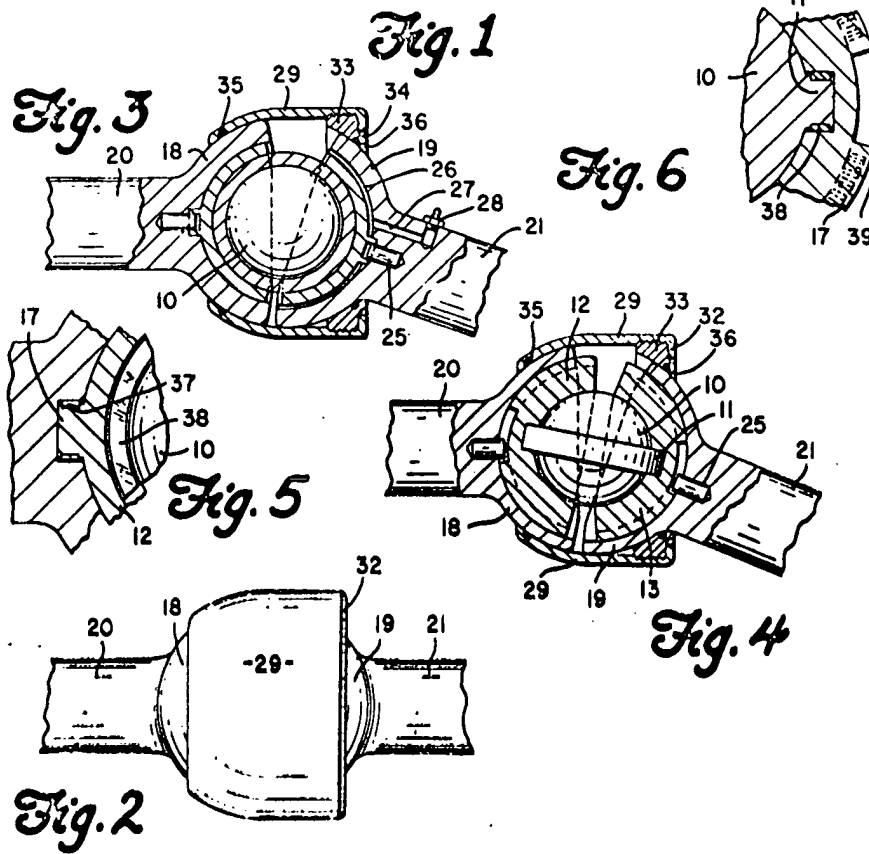
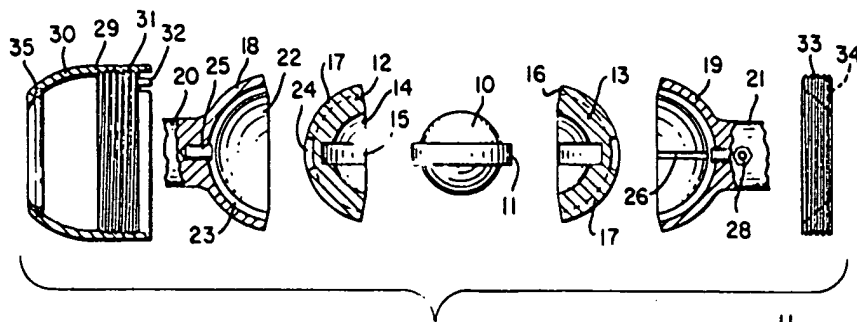


Fig. 7

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2 - 2



6045 36

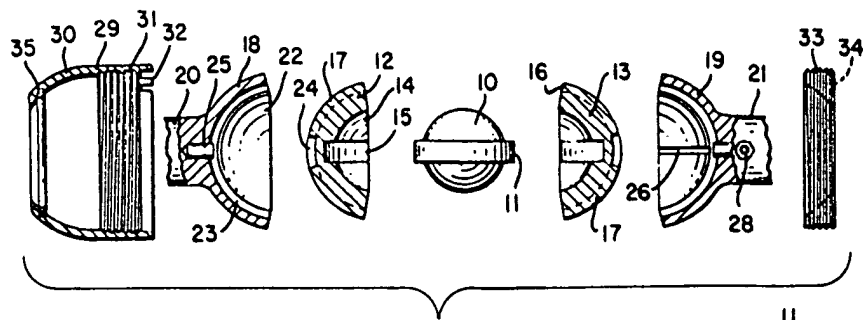


Fig. 1

Fig. 3

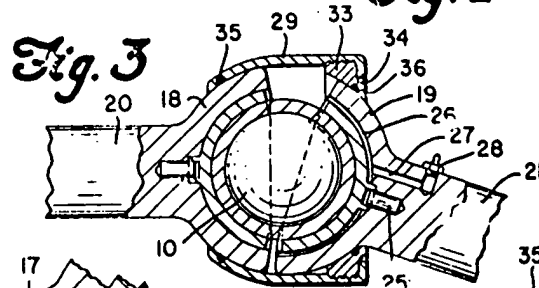


Fig. 6

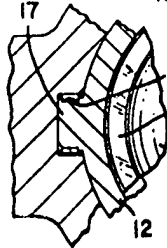
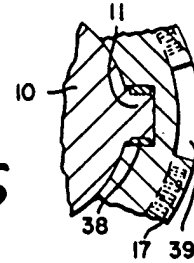


Fig. 5

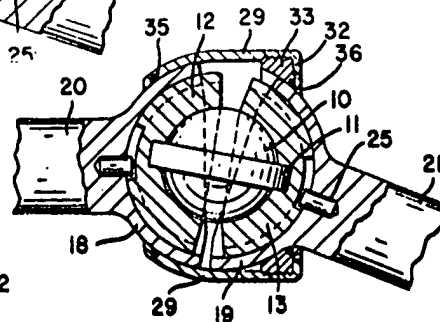


Fig. 4

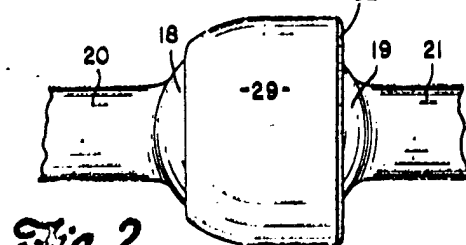


Fig. 2

6045 36

Patent No. 604,536

Constant Velocity Universal Joint

Emil A. Helmke, Port Clinton, Ohio, U.S.A.
Application March 13, 1958, Serial No. 747,424
7 Claims

This invention relates to constant angular velocity universal joints and objects of the invention are to produce a joint of this character which can be economically manufactured and assembled on a large quantity production basis; which has a minimum of parts and is relatively easy to assemble during the manufacturing process; which embodies parts which can be manufactured without difficulty; which embodies a freely movable part for transmitting torque and for all practical purposes will not bind and can be readily lubricated; and which has the new and improved features of construction, arrangement and operation hereinafter described.

For purposes of illustration but not of limitation, an embodiment of the invention is shown on the accompanying drawings in which

Figure 1 is an exploded view shown in vertical sectional elevation and in elevation of the various parts which make up the joint;

Figure 2 is a side elevation of the assembled joint, the shaft members being shown in fragment;

Figure 3 is a longitudinal sectional elevation of the assembled joint with the shaft members angularly disposed to each other;

Figure 4 is a longitudinal sectional view of the joint similar to but taken through a different plane than that of Figure 3;

Figure 5 is an enlarged fragmentary view showing the anti-friction bearing disposed between an outer shell member and the juxtaposed coacting member;

Figure 6 is an enlarged fragmentary sectional view showing anti-friction bearing members for the central spherical element and associated with the intermediate coacting member; and

Figure 7 is a longitudinal sectional elevation of an alternate form of joint.

The illustrated embodiment of the invention comprises a constant velocity universal joint which embodies a solid metallic ball or sphere 10 which is disposed at the center of the joint. Rigid with and preferably integral with the sphere 10 is an outwardly extending cylindrical flange or key 11 having flat opposite sides and being disposed centrally of the sphere so that equal portions of the sphere are arranged on opposite sides of the key 11. As will hereinafter appear, all driving force transmitted from the driving to the driven parts is transmitted through the sphere 10 by way of the cylindrical key 11.

On each side of the central sphere 10 are substantially semi-spherical shells 12 and 13 which are identical. The inside surface of each of the shells 12 and 13 is semi-circular and intimately fits the juxtaposed surface of the sphere 10 and has a nice sliding fit thereon. In each of the shells 12 and 13 is a semi-circular key way 15 into which portions of the key 11 slidably fit. It will be understood that the shells 12 and 13 are dimensioned so that when fitted to the central sphere 10 they do not abut each other. On the contrary slight spacing is provided between the facing surfaces of these two shells when the up and down edges thereof are substantially

parallel. It will also be observed that the inner edges of the shells 12 and 13 incline rearwardly as indicated at 16. The outer surface of each of the shells 12 and 13 is also substantially semi-spherical and concentric with the inside substantially semi-spherical contour. The thickness of the shells 12 and 13 is so chosen that adequate strength is afforded these parts after the key way 15 has been formed. At exactly 90° to the key way 15 of each of the shells is a key 17 which projects outwardly beyond the dome-like outer surface of each shell.

On the outside of the shells 12 and 13 are main exterior shells 18 and 19 respectively, the shell 18 having a shaft part 20 which is the driving end of the joint and the shell 19 having a shaft part 21 constituting the driven part of the joint. The exterior shells 18 and 19 are of the same construction except that the shell 19 is provided with lubricating means which will be hereinafter described. As shown, each of the main exterior shells has an inner substantially semi-spherical surface 22 contoured to have a nice sliding fit with the exterior surface of the adjacent inner shell. On the inside of each of the shells 18 and 19 is a key way 23 for slidably receiving the key 17 of the adjacent inner shell so that a sliding fit is obtained between these parts. The key-way 23 is bisected by the axis of the shaft part 20. As shown there is a slot 24 disposed centrally of each exterior shell and into the slot extends a rigid pin 25 which limits the rocking movement of the respective main shell relative to the adjacent inner shell 16 or 17.

The outer surface of each of the main shells 18 and 19 is dome shaped, the curvature of which is concentric to that of the sphere 10. Thus the various semi-spherical surfaces on opposite sides of the central sphere 10 are concentric to such sphere.

At the driven end of the joint, in the main exterior shell 19 is a grease groove 26 which extends from one free end to the other and intersecting the groove 26 is a passage 27 which communicates with a grease fitting 28.

The parts of the joint are retained in assembled relation by a housing having a main straight tubular body 29, the inner end of which is curved as indicated at 30 to conform to the curvature of the outer surface of the adjacent main shell 18 and the opposite end portion is provided with a series of screw threads 31 on the inside thereof. Thus the main body 29 has a sliding fit with the main shell 13, and it is of sufficient length to extend over the parts of the joint and of such diameter as to clear same. At the outer end of the body adjacent the screw threads is a series of fingers or tabs 32 which are spaced from each other and extend throughout the circumference of the housing part. In screw-threaded engagement with the thread 31 of the main housing body 29 is an externally threaded ring 33 which has a curved inner surface 34 slidably fitting the exterior surface of the main shell 19. In the outer end of the ring 31 is an annular row of spaced grooves 34 into which the fingers 32 are bent thereby securing the housing parts together and preventing relative turning movement between these parts. It is not necessary that there be sufficient of the grooves 34 to accommodate each of the fingers 32 so that some of the fingers may be bent over the outer end of the ring 33. In the housing part 29 is an

3

annular groove 35 to receive a grease seal and likewise in the inside of the ring 33 is a groove 36 to receive a grease seal.

Figure 5 shows an alternate form in which the key 17 of each of the inner shells is provided with anti-friction thrust bearings 37 on each side and for this purpose manifestly additional clearance must be afforded in the width of the key and the key way receiving the same to admit these bearings.

In Figure 6 the key 11 is shown provided with anti-friction bearings 38 and opposite sides of the key 17, grooves are formed to enable the installation of anti-friction bearings 39, a portion of the key being left on each end to prevent the bearings from working out of the key way as indicated at 39.

From the above description, it will be manifest that the inner shells 16 and 17 are free to rock in one direction or the other on the sphere 10 as well as relative to the respective main shells 18 and 19. When the joint is operating at an angle, these parts slide freely in both of these directions, maintaining the key ways 23 in the main shells 18 and 19 in perfect alignment with each other. These internal movements of the joint parts are self-compensating in their true round contained position. This constant true alignment of the key ways of the main shells 18 and 19 makes possible the delivery of a constant velocity.

In the alternate form shown on Figure 7, instead of the pin 25 and slot 24 connection, a pair of oppositely arranged spring tensioned pistons 40 are slidable in the exterior shells 18 and 19 respectively. The pistons 40 engage flattened surfaces 41 on the shells 12 and 13 respectively, thereby tending at all times to centralize the driving and driven shells.

Numerous changes in details of construction, arrangement and choice of materials may be effected without departing from the spirit of the invention, especially as defined in the appended claims.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A universal joint comprising an exterior driving shell, an exterior driven shell, an interior shell for said driving shell, an interior shell for said driven shell, a central free floating sphere engaged by both interior shells, a continuous cylindrical key integral with and surrounding said central sphere, a key way in each interior shell receiving a portion of said sphere key whereby the driving and driven shells are maintained at 180° angularity, interfitting keys and key ways connecting said interior shells and the respective driving and driven shells and arranged at 90° relative to said sphere key, the engaging surfaces of said interior and exterior surfaces being curved and concentric with said central sphere, and a housing enclosing said exterior shells for retaining the parts assembled.

2. A universal joint comprising an exterior driving shell, an exterior driven shell, an interior shell for said driving shell, an interior shell for said driven shell, means for centralizing each interior shell relative to its respective exterior shell, a central free floating sphere engaged by both interior shells, a continuous cylindrical key surrounding said central sphere, a key way in each interior shell receiving a portion of said sphere key whereby the driving and driven shells are maintained at 180° angularity, interfitting keys and key ways connecting said interior shells and the respective driving and driven shells and arranged at 90° relative to said sphere key, the engaging surfaces of said interior and exterior surfaces being curved and concentric with said central sphere, and a housing having separable parts enclosing and having curved bearing surfaces slidably

4

engaging said exterior shells for respectively retaining the parts assembled.

3. A universal joint comprising an exterior driving shell, an exterior driven shell, an interior shell for said driving shell, an interior shell for said driven shell, a central sphere engaged by both interior shells, a cylindrical key surrounding said central sphere, a key way in each interior shell receiving a portion of said sphere key, interfitting keys and key ways connecting said interior shells and the respective driving and driven shells and arranged at 90° relative to said sphere key, the engaging surfaces of said interior and exterior surfaces being curved and concentric with said central sphere, a housing part in the form of a straight tubular body having an interiorly curved surface at one end slidably fitting one of the exterior shells, an interiorly screw threaded portion at the other end of said body, an exteriorly screw threaded ring engaging said interiorly screw threaded portion and having an interiorly curved surface slidably fitting the other exterior shell, and means for retaining said housing and ring in assembled relation.

4. A universal joint comprising an exterior driving shell, an exterior driven shell, an interior shell for said driving shell, an interior shell for said driven shell, a central sphere engaged by both interior shells, a cylindrical key surrounding said central sphere, a key way in each interior shell receiving a portion of said sphere key, interfitting keys and key ways connecting said interior shells and the respective driving and driven shells and arranged at 90° relative to said sphere key, the engaging surfaces of said interior and exterior surfaces being curved and concentric with said central sphere, a housing part in the form of a straight tubular body having an interiorly curved surface at one end slidably fitting one of the exterior shells, an interiorly screw threaded portion at the other end of said body, an exteriorly screw threaded ring engaging said interiorly screw threaded portion and having an interiorly curved surface slidably fitting the other exterior shell, and finger and notch means on said tubular body and ring respectively for holding the housing parts in predetermined assembled relation.

5. A universal joint comprising an exterior driving shell, an exterior driven shell, an interior groove on said exterior driven shell for grease, means for forcing grease to said groove from the outside, an interior shell for said driving shell, an interior shell for said driven shell, a central sphere engaged by both interior shells, a cylindrical key surrounding said central sphere, a key way in each interior shell receiving a portion of said sphere key, interfitting keys and key ways connecting said interior shells and the respective driving and driven shells and arranged at 90° relative to said sphere key, the engaging surfaces of said interior and exterior surfaces being curved and concentric with said central sphere, a housing part in the form of a straight tubular body having an interiorly curved surface at one end slidably fitting one of the exterior shells, an interiorly screw threaded portion at the other end of said body, an exteriorly screw threaded ring engaging said interiorly screw threaded portion and having an interiorly curved surface slidably fitting the other exterior shell, grease seals on the outer end of each of said body and ring, and means for retaining said housing and ring in assembled relation.

6. A universal joint as claimed in claim 5 comprising anti-friction bearings on opposite sides of each of the keys.